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THE DEVELOPMENT OF THE NATURAL SCIENCES IN CHINA[1]

By Dr. AMADEUS WILLIAM GRABAU

THE GEOLOGICAL SURVEY OF CHINA

I AM deeply conscious of the honor which you, the foremost body of scientific men of my country, have conferred upon me.

That I have been able to take an active part in the development of the natural sciences in China has been due, in the first place, to the fact that my coming to Peking has coincided with the awakening of interest in, and desire for scientific education along western lines, among the Chinese intellectuals.

The Geological Survey of China had been founded a few years before, and it had but recently completed its first task—the training of a number of men in the fundamentals of geological science.

It was still housed in an old adapted and inadequately equipped compound, with a library consisting of a few hundred books, and a few drawers of Chinese Paleozoic fossils. But, new buildings were under construction, and under the energetic guidance of Drs. Chang, Ting and Wong, phenomenal progress was made in the equipment and acquisition of material and the investigation of Chinese geology. Dr. J. G. Andersson, foreign adviser to the Survey, had organized the scientific exploitation of the important deposits of fossil vertebrate remains and the study of these was undertaken by foreign paleontologists.

To me was assigned the study of the Chinese invertebrate fossils, while my task at the university has been the training of young Chinese paleontologists and stratigraphers.

Through the efforts of Dr. Andersson a fund had been provided to begin the publication of the Paleon-

[1] Remarks on receiving the Mary Clark Thompson Medal of the National Academy of Sciences. Read by Mrs. Grabau in the absence of Dr. Grabau in China.

tologia Sinica in four series: A. Fossil Plants; B. Fossil Invertebrates; C. Fossil Vertebrates, and D. Ancient Man. The support of this was subsequently taken over by the Survey.

The first two fascicles which I prepared appeared one in April and the other in September, 1922. Since then 95 fascicles have been issued with a total of 8,760 quarto pages and 844 plates. If we add the fascicles in press, or prepared, the total number of fascicles is well over a hundred, with more than 9,000 pages. The smallest fascicle comprises 14 pages and 1 plate, and the largest 441 pages and 31 plates.

The first paleontological memoir, written by a Chinese paleontologist, Dr. Y. C. Sun, appeared in 1924, and of the 43 fascicles of Series B, so far issued, 32 have been written by Chinese. Nearly all these are graduates of the National University.

At first graduate students had to be sent abroad for the study of vertebrates, but in recent years the preliminary training of workers in that field is carried on in Peking. This was made possible by the founding of the Cenozoic Laboratory of the Survey, which now takes care of all the work on fossil vertebrates, including the researches on the Peking Man (*Sinanthropus pekinensis*) under the direction of Drs. Weidenreich and Young and Pere Teilhard de-Chardin. Additional impetus had previously been given by the explorations of the Third Asiatic Expedition under Dr. Andrews and the coming to Peking of such internationally famous men as Granger, Matthew Nelson, Chaney, Berkey and the Swedish scientists under Sven Hedin, and his royal highness the Crown Prince of Sweden, an active patron of science.

The Survey has since acquired the Chaukoutien site and provided the necessary equipment for the extensive exploitation of these now famous deposits of the remains of ancient man.

The Soil Survey and Seismological Observatory in the Western Hills are other lines along which the Survey has branched out, in addition to its active pursuit of the study of the structural geology and economic deposits of China and the making of geological maps.

In 1920 the geological department of the university was reorganized and under the guidance of such leaders as Drs. J. S. Lee, C. Y. Hsieh and the late V. K. Ting and others it developed rapidly. It is now housed in a building of its own, well equipped with lecture halls, laboratories, museum and library. The geological faculty consists of seven professors, two lecturers and four assistants.

Of the several hundred graduates of the department, the great majority is still in active geological work. Many of them are members of the national or of the various provincial surveys; others are teaching in various universities. The department now has resumed issuing its series of contributions, of which twelve have appeared, while others are in press.

In 1922, the Geological Society of China was organized with twenty-six charter members. At the first meeting (March 2) thirty-six new fellows and nine associates or student members were elected. Fifteen papers were presented, and the first volume of nineteen nine pages was published that year. Volume IV totalling 574 pages, appeared in four parts during 1936.

At the annual meeting in February, 1937, six papers were presented and the membership was as follows:

Number of fellows	320
Number of student associates	66
Number of foreign corresponding members	36
Number of living honorary members	1
Number of institutions, listed as members	6
Total	429

When I came to China, a Chinese fellow passenger, Dr. C. C. Ping, was returning after several years of study at Cornell University. It was an opportunity for discussing plans to develop research in natural history in China, for Dr. Ping was to take charge of the biological laboratory of the Science Society of China. This society was organized a few years previously for the promotion and diffusion of science. It publishes a monthly journal *Science* in Chinese, which is now in its twenty-first year. Active work in the investigation of the fauna and flora of Central China was begun at once under Dr. Ping, the results appearing in English in numerous bulletins issued at irregular intervals. In Peking we organized the Peking Laboratory of Natural History, under the sponsorship of Mr. Sohtsu King, who has since become one of China's patrons of science. During two seasons he maintained a seaside laboratory at Peitaiho, where we collected material for our illustrated guide to the shells of Peitaiho, in which 120 species were described and figured. Mr. King, who has since been elected to membership in several foreign malacological and conchological societies, has brought together the most complete library on conchology in China, and he and Dr. Pi are periodically issuing fascicles on the South China shells.

When the Fan Memorial Laboratory of Biology was organized, it took over most of the plans of the original Peking Laboratory, including the publication of the Zoologia Sinica, and extensively developed them, and since moving into its new and well-equipped quarters, it has become one of the leading biological research institutions of China.

Another direct outcome of the early activities of the Peking Laboratory of Natural History was the organ-

tion of the Peking Society of Natural History in 25. The call was issued by Dr. N. Gist Gee, the nithologist, as organizing secretary, and myself as nvener, and the first meeting was held on September , with thirty-eight charter members.

Monthly meetings have been held ever since, with tures and discussions on Chinese natural history. uring the first year the membership rose to 101, inding eighteen foreign correspondents and two honary members. The society began at once to issue a lletin, the first volume of 450 pages appearing in 26. The present membership is 160 active members, foreign correspondents and 4 honorary members, d the bulletin is now in its eleventh volume.

Besides this the society has undertaken the issue of e handbooks, of which four have appeared: (1) Flowers of Peitaiho," by R. D. Wickes; (2) "Shells Peitaiho," by Grabau and King, second edition; (3) Hand-book of North China Amphibia and Reptiles," y Drs. Boring, Liu and Chou, and (4) "Familiar rees of Hopei," by H. F. Chow.

In addition the society has issued five monographs on Chinese medicinal plants and animal drugs, by Dr. Bernard Read, and one on minerals and stones used in medicine, by Drs. Read and Pak. It has also brought out a profusely illustrated manual of the dragon-flies of China, by Dr. J. G. Needham.

The scientific study of natural history is now a recognized intellectual pursuit in China, and those of us who were privileged to be present and in a measure give aid, during the early years of development, feel confident that in the years to come geological, paleontological, biological and archeological contributions by Chinese naturalists will become of increasing importance, not only to their home country, but to the world of science at large.

Chinese naturalists feel as I do, that in honoring me to-night you are giving recognition to the progress of the scientific work in China, and they take it as an encouragement for the unabated continuance of their endeavors.

With this interpretation of your award to me of the Thompson Medal and with my sincere personal thanks, I accept the honor.

THE SOCIAL RESPONSIBILITY OF THE ENGINEER.[1]
II

By Dr. F. G. COTTRELL

RESEARCH ASSOCIATES, INC., WASHINGTON, D. C.

The particular project out of which have thus far olved the Research Corporation and the Research ssociates, Inc., originated over 30 years ago at the niversity of California primarily in the attempt to ake certain technical developments arising in the boratories more certainly and usefully available as ractical results to the public on the one side and on e other securing therefrom some financial return ward further research in these laboratories.

The idea was not a new one even at that time, but oncrete systematic attempts at its realization were w and scarcely any had as yet attracted much public ttention.

The particular technical developments and patents iving us a basis to work on at the time happened to oncern the application of electricity for the suppresion of dust and smoke discharge from smelters and hemical works, some of which were then in serious itigation with surrounding agricultural regions. The cientific and technical side of this story though interesting in itself is not what I wish to cover to-night, s it is already fully available in the now voluminous ublished literature on the subject.[2]

Suffice it to say that these electrical methods, though originally proposed and even patented in their broadest general terms a quarter of a century earlier, had never up to then been successfully engineered and applied in industry. The work started purely as a private venture, a summer vacation's excursion into the technical commercial field when it was drastically necessary to supplement a university instructor's salary by outside work of some sort. It soon involved three associates besides myself, all alumni of the university, *viz.*, Dr. Harry East Miller, a consulting chemist (the only other member of our group still living), Professor Edmond O'Neill, of the Chemical Department, and Mr. E. S. Heller, a lawyer of San Francisco. They jointly financed the undertaking, including patents and early experimental work. As we proceeded, the scope and importance of the field we had stumbled upon gradually became evident.

None of us looked to this particular work as anything but a passing, though interesting and useful, incident of our chosen careers. Early in its development we therefore planned for its eventual liquidation as far as we as a group were concerned, but agreed that in so doing we would if possible segregate a part of the patent rights and turn them over to the univer-

[1] Address on the occasion of the presentation of the Washington award at a meeting of the Western Society of Engineers, Chicago, February 23, 1937.

[2] For brief summary and selected bibliography see "Fume Precipitation, Electrical," Encyclopaedia Britannica, 14th Edition, Vol. 9, p. 914, *et seq.*

sity or some other appropriate body as nucleus and example of this particular sort of endowment for further scientific research.

It took five years and an investment of over $20,000, tenfold the original estimate of both time and money, before we reached even a promising point to pause and attempt such liquidation and transfer of patent rights. In the meantime (1907) we found it expedient to incorporate two companies, the Western Precipitation Company, handling actual installation of the process at home, and International Precipitation Company, holding the foreign patents for which our perhaps amateurish enthusiasm had led us to apply in some sixteen countries.

Our five years' experience made us skeptical of the expediency of universities themselves attempting to administer the commercial development or licensing of patents, partly from the difficulty and financial hazards of the business but even more from the danger of its reaction on the aims and outlook of the institutions, including the possibility of gradual development of commercial competition among them and resulting interference with free exchange of scientific ideas.

This led to our turning to the national scientific societies as possible trustees in such matters for all the universities and other academic research institutes as a group, but none of these national societies felt they could undertake it. The quest finally led us to the Smithsonian Institution, which, though hesitating to undertake the task itself, sponsored an attempt to get together a volunteer group of nationally recognized men, representing both business and science, to form a business corporation to take over these and any other patent rights that might be offered from time to time from any source as endowment for science. It took two months to get a board of 15 together and perfect plans. As the result Research Corporation was chartered on February 26, 1912, just 25 years ago next Friday, under the laws of New York State with an authorized capital of $20,000, of which $10,100 was paid in practically as a loan without interest by the directors themselves and a few others interested in the experiment.

I well remember one of these latter remarking at the time: "Your project of a non-profit but business corporation strikes me as too bizarre and self-contradictory to succeed, but if these busy and successful business men you have secured as directors are willing to give their time and effort to the experiment, they can count on me for a thousand dollars toward trying it out." Nor do I recall that he was any more frankly surprised three years later when he got his money back out of earnings than some of the directors themselves. At the start it was frankly "An Experiment in the Public Administration of Patent Rights." At least that is what I called it in the title of a paper written at the time, though I am not sure that even a majority of its original board of directors took that aspect of the project as seriously as I did. They saw it primarily as just so much more endowment for science and possibly if successful, as facilitating and encouraging future additions in kind, but even of this latter some were frankly skeptical.

Nor was there lack of justification for this skepticism. It has taken good hard work over the years by an intelligent and devoted staff sympathetically supported and guided by an interested and unselfish board to accomplish the success manifest to date.

At the time of organizing Research Corporation the investment of the original California group had not yet even begun to be repaid, but the business outlook for the Western Precipitation Company seemed encouraging. I was leaving the university faculty for service with the U. S. Bureau of Mines especially on smelter fume problems closely connected with litigation thereon, so it was necessary to completely separate myself from any financial interest bearing on the subject. This precipitated similar action on the part of my three associates. Some of our clientele among the smelters and chemical works where a number of electrical precipitation plants were under construction were somewhat perturbed at the prospect of becoming guinea pigs in the Research Corporation experiment through absorption of Western Precipitation Company therein and so expressed themselves. Some of the younger men in our technical staff were quite anxious to carry on by themselves, and this permitted a very happy solution by which one of them, Mr. Walter A. Schmidt, another University of California alumnus and former student there of mine, headed a group to take over, refinance and practically consolidate the Western and International Precipitation Companies under the former, after we had segregated and turned over to the Research Corporation entirely unencumbered all the United States patent rights to the precipitation business east of the Rocky Mountains except the one application to the Portland Cement industry which Mr. Schmidt had already personally built up over several years under an earlier license from us.

This also incidentally provided a very interesting yardstick alongside of the Research Corporation experiment, for Western Precipitation Company continued on as a normal privately owned enterprise operating under the same patents and among the same industries in a different geographic field in part of its work and with a different industry but in the same geographic field as Research Corporation in another. An agreement was early reached between the two corporations for the free exchange of all new information and patents on electrical precipitation and has later

grown to include similar organizations in many foreign countries.

But to return to the Research Corporation itself: We had pictured its functions as primarily hunting up business, negotiating licenses and collecting royalties. However, experience soon showed that even in as new an art as electrical precipitation, where we were the recognized pioneers of its effective industrial application, it was necessary for the corporation to furnish its clientele not only licenses but active and vigorous service in detailed design and leadership in adapting the new art to the special conditions of each industry and even each individual plant. Otherwise failures due to such details were viewed as fundamental limitations of the process as such and seriously cramped further growth and expansion. On the other hand, too, if the client solved the new difficulties unaided he quite naturally and properly was apt to take out patents of his own covering it. Now there is nothing more discouraging to the prospective user of a new process than to find that he may have to shop around among several interests to collect the patent rights he needs.

The realization of this early forced the Research Corporation to take an active and responsible part in the design and supervision of installations under its patents, and finally led it as the only satisfactory way to the building up of its own construction department and contracting to put in and guarantee performance of the whole equipment.

I mention this to illustrate how inexorably responsibilities grow in the economic field even in an organization which started out with apparently so simple a program.

Another important difference in the actual course of events as compared with the original plans and forecasts lay in the slower development of income both from electrical precipitation and from other business than many had expected.

From the very start the corporation was, to be sure, deluged with offers of patents and patentable ideas on all sorts of terms by all sorts of inventors. Hundreds of these cases were carefully investigated at considerable expense. Definite attempts to commercialize a few were made, and much assistance was incidentally given to a large number of applicants in the way of technical and legal advice and in making favorable contacts with firms and industries who might be interested in the further development of projects in cases where the Research Corporation did not feel itself in a position to proceed further.

Only relatively recently, however, has the corporation begun to receive significant financial returns outside the electrical precipitation field, but these seem now to be steadily growing, both in number and importance, and they include as widely different subjects as air conditioning, both for buildings and railway service, sewage disposal and pharmaceutical products.

Perhaps the most significant lesson out of all this, particularly for the purpose of our discussion this evening, is, on the one hand, the demonstration that it is entirely possible to organize and efficiently operate over long periods of years, on a thoroughly sound business basis, a corporation of the type here described in which there are no dividends to individual stockholders, no bonds or other long-term borrowings entailing heavy interest payments which in slack business seasons embarrassingly compete with wages and salaries, while, on the other hand, it equally illustrates the difficulty and general inexpediency of trying to handle intensively more than one new thing at a time, especially when getting under way with a new organization. But this is just the reason why this very method of organization presents, I believe, a particularly suggestive challenge to the engineer with new ideas who may be finding it difficult to get them tried out under conditions acceptable to him, through older established channels in industry and trade.

While the Research Corporation finds itself almost chronically in a condition near saturation and ofttimes actually supersaturated in regard to new commitments in the development field, and therefore must select very carefully and conservatively among them, it has come to be a very large part of its public service functions to aid and advise others who seriously contemplate entering this field.

There has also come to be a constant exchange of information and assistance going on between it and other similar organizations, such as the university research foundations, National Research Council, the various technical departments of the Government, the Chemical Foundation, the Ontario Research Foundation, and many others. So much so in fact that among this group it is being considered whether some sort of intergroup organization, to arrange for regular meetings of representatives for the discussion of common problems and aims, has not already become highly expedient. This might quite conceivably be the next step in the development of this part of our social-economic pattern.

At the outset Research Corporation's income was small and slow growing. Its capital was gradually eaten into, reaching a minimum of about $3,000 in the third year of operations, shortly after which the first considerable license contracts were entered into with some of the large smelting companies and the corporation's reserves rapidly increased, reaching a maximum of slightly over $200,000. But conditions of the world war and the post-war depression again ate steadily

into these reserves until in 1926–7 they were once more just about dragging on bottom, when a slow but steady climb again set in with naturally a decided spurt in the boom year of 1929 and lasting well into 1930, again building up a substantial reserve sufficient to more than completely meet actual deficits suffered in 1931 to 1933, as well as to permit the corporation to continue its grants for pure scientific research at the Smithsonian Institution and a number of universities and other research centers, totalling $50,000 to $75,000 a year. The past two years have again been "in the black" and 1937 opens with encouraging prospects.

Nearly a decade ago, when the Research Corporation began to feel itself gradually emerging from the effects of the post-war depression and keenly realizing the difficulties of too closely mixing operation and construction technique with research in a new field, it decided to set up a modest branch laboratory, primarily for this latter purpose, in Washington, D. C., which would also supply a much needed link with a large store of technical information available there through the libraries and information services of the various scientific departments.

Through the friendly cooperation of the Smithsonian Institution modest temporary quarters for this step were soon found and work started, particularly along lines growing out of activities to which the Research Corporation was already committed. One of the more important projects resulting from this move and which will serve to illustrate the work in a general way, was the cooperative investigation undertaken with the Tennessee Valley Authority (then just established) and the Department of Agriculture, having to do with semi-commercial tests and development in the application of blast furnace technique to the production of phosphate fertilizers.

By the end of 1934 the work at Washington had developed to a point where the directors of the Research Corporation felt it expedient, in conformity with the general policy of decentralization indicated above, that this Washington work should be given a more independent status and thus, among other objects, stimulated to become more definitely and rapidly self-supporting and eventually take its place alongside of the Research Corporation, functioning in much the same way but on separate technical projects and with an entirely separate board of its own.

It was felt that this budding-off process might become one of the most effective ways of providing for wider public service in this promising field and also to a drafting in and giving full scope to new personal initiative.

Accordingly, the Research Associates, Inc., was chartered on January 3, 1935, and has been operating ever since with a staff of ten or a dozen people housed in several temporary small laboratory buildings, mostly relics of the chemical warfare unit of war days, on about an acre of ground, part of the campus of the American University and immediately adjacent to the old Fixed Nitrogen Research Laboratory of the U. S. Department of Agriculture.

Thus far the new corporation has been supported almost entirely by grants from the Research Corporation, but it is hoped that by the end of the present year it will have become self-supporting from its own developments. The first to emerge will probably be in the field of non-glare automotive lights on the one hand, and certain improvements in the soap and detergent industry on the other; with a more ambitious long range program already well under way on fundamental improvements in heat exchange, especially in high temperature chemical and metallurgical industries and power production. But the new corporation, though an interesting and lusty youngster, is still distinctly not out of its swaddling clothes, and, as even in this modern age the old adage that "children should be seen but not heard" is still reasonably applicable, Junior, I trust, may, with this brief introduction, be allowed to retire again to the nursery until there are more definite accomplishments to report.

SCIENTIFIC EVENTS

THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR

THE summer activities of the Biological Laboratory of the Long Island Biological Association at Cold Spring Harbor will open on June 21 with the first meetings of the course in surgical methods in experimental biology and the course of experimental endocrinology. The class in surgical methods, which is now over-registered, is again being given by Dr. George W. Corner, of the University of Rochester, while that in experimental endocrinology is being given by Dr. H. O. Haterius, of the Ohio State University, and Dr. Robert Gaunt, of New York University. The Davenport Laboratory, in which these classes are being held, has been completely remodeled, and accommodations for an animal colony have been added.

The fifth of the Cold Spring Harbor symposia on quantitative biology begins on June 22 and continues for five weeks. This year the subject is that of internal secretions, with special emphasis on their chemical aspects and on bio-assay. The program falls into three main sections—I. Pituitary and gonad hormone chemistry (first week); II. Pituitary-gonad relations (second and third weeks), and III. Hormones and

metabolism (fourth and fifth weeks)—and is made up of 45 papers read by 43 contributors. The participants will be in residence at the laboratory for all or an appreciable part of the five weeks' period. Investigators who are interested may attend and take part in the discussion of the papers, and programs will be sent on request. The papers, together with edited discussion, will be published as Volume V of the Cold Spring Harbor Symposia on Quantitative Biology and will be ready for distribution early in November.

Commencing on August 2, the laboratory is offering courses in marine and fresh-water zoology, given by Dr. Herman T. Spieth, of the College of the City of New York, and Dr. William A. Castle, of Brown University, and in plant sociology, given by Dr. Stanley A. Cain, of the University of Tennessee. These combine laboratory work with field work, making use of the great variety of habitats which are found within easy working range of Cold Spring Harbor.

The research work which will be in progress during the summer is in part a continuation of the all-year-round work in biophysics and physiology, and in part the work planned by visiting investigators. The problems of special interest this summer include: the study of surface conductance and the interpretation of impedance measurements on cell membranes; the effect of x-rays on various complex organic molecules; electrophoretic investigations of protein surfaces and of the surfaces of red and white cells under various conditions; the estimation of histamine in blood by iontophoresis; investigations on intravascular hemolysis, particularly in relation to toxic benzol derivatives; the synthesis of simple hemolytic glucosides; the metabolism of different varieties of white cells, and the light transmission cell properties of cell suspensions. Drs. Haterius, Gaunt, Nelson and Donahue will also be working upon a number of problems in endocrinology, and it is hoped this summer to commence projects on the hematology of the fishes.

As in past years, a series of evening lectures on scientific topics of general interest have been arranged, and these lectures are given each Tuesday throughout the season. Dr. Harold A. Abramson will also give a series of five lectures on "Allergy and its Mechanisms" on Fridays from June 25 onwards. These lectures will deal with allergic phenomena from the standpoint of physics and physical chemistry.

Those interested may obtain further information by writing to Dr. Eric Ponder at the Biological Laboratory.

THE NEW ORLEANS MEETING OF THE AMERICAN ASSOCIATION OF MUSEUMS

Museum News reports that the New Orleans meeting of the American Association of Museums, which met on May 3, 4 and 5, drew an attendance of 200 members, of whom more than 150 were out-of-town delegates.

Papers read at this, the first meeting in the South since the Charleston meeting of 1923, brought out the fact that museum conditions in that section have changed materially in the past year and a half. At least ten new museum buildings have been constructed in the South during that period, work has been begun on an eleventh, and plans have been drawn and work done on exhibits for a twelfth. In addition two old buildings have been converted to museum use; a number of new museums have been opened in National Park and Monument headquarters, and many old structures have been made into historic house museums. Every state south of the Mason and Dixon line has shown some new museum activity, and in the number of new museum buildings erected Texas led the nation.

Herbert E. Winlock, director of the Metropolitan Museum of Art, was reelected president of the association. Section chairmen were elected as follows: Art Section, Wilbur D. Peat, director, John Herron Art Institute, Indianapolis; Education Section, Thomas Munro, curator of education, Cleveland Museum of Art; History Section, Henry C. Shetrone, director, Ohio State Museum, Columbus; National and State Parks Section, William H. Carr, director, Bear Mountain Trailside Museums, Palisades Interstate Park; Public Relations Section, Sarah Newmeyer, publicity director, Museum of Modern Art, New York; Science Section, Charles M. B. Cadwalader, president, Academy of Natural Sciences of Philadelphia; Science Technical Section, Charles R. Toothaker, curator, Philadelphia Commercial Museum; Superintendents Section, John W. McCabe, superintendent, Cleveland Museum of Art. Morgan C. Marshall, director, Walters Art Gallery, Baltimore, continues as chairman of the Art Technical Section and H. L. Story, registrar, Museum of Fine Arts, Boston, of the Registrars Section. A new section, the Children's Museum Section, was organized, under the chairmanship of Mrs. Dean Clay Osborne, chairman of the Women's Auxiliary of the Brooklyn Children's Museum.

The association passed a resolution endorsing the efforts of the State of Louisiana and the City of New Orleans to preserve historic buildings and areas and commending the work already done toward this end.

At the invitation of all the museums of the city Philadelphia was chosen as the meeting place for 1938.

HONORARY DEGREES CONFERRED BY CLEMSON COLLEGE

ON the occasion of the dedication of Long Agricultural Hall at Clemson College on May 12, the doctorate of science was conferred on the following:

Henry D. Barker, senior pathologist, Bureau of Plant Industry, U. S. Department of Agriculture.

Henry Walter Barre, principal pathologist, Bureau of Plant Industry, U. S. Department of Agriculture.

Hugh Hammond Bennett, chief, Soil Conservation Service, U. S. Department of Agriculture.

Cloide Everett Brehm, director, Agricultural Extension Work, University of Tennessee.

Harry Lowrance Brown, assistant secretary, U. S. Department of Agriculture.

Thomas Stephen Buie, regional conservator, Soil Conservation Service, U. S. Department of Agriculture, Spartanburg, S. C.

Paul Wilber Chapman, dean, College of Agriculture, the University of Georgia.

Cully Alton Cobb, director, Southern Division, Agricultural Adjustment Administration, Washington, D. C.

David Robert Coker, president, Coker's Pedigreed Seed Company, Hartsville, S. C.

Thomas Poe Cooper, dean, College of Agriculture, director, Agricultural Experiment Station and Extension Service, the University of Kentucky.

Chester Charles Davis, member, Board of Governors, Federal Reserve System, Washington, D. C.

Ivy William Duggan, assistant director, Southern Division, Agricultural Adjustment Administration, Washington, D. C.

James Allen Evans, administrative assistant, Extension Division, College of Agriculture, the University of Georgia.

George Elbert Freeman, head, Division of Vocational Education, state supervisor of vocational agriculture, Nashville, Tenn.

Marion Jacob Funchess, dean, School of Agriculture; director, Alabama Experiment Station, Alabama Polytechnic Institute, Auburn.

Wightman Wells Garner, principal physiologist, Bureau of Plant Industry, U. S. Department of Agriculture.

Edward Walter Garris, professor of agricultural education, College of Education and College of Agriculture, the University of Florida.

Wilson Gee, professor of rural social economics, director of the Institute for Research in the Social Sciences, the University of Virginia.

Dan T. Gray, dean, College of Agriculture; director, Agricultural Experiment Station and Extension Service, the University of Arkansas.

Hardrada Harold Hume, assistant dean, research, College of Agriculture; assistant director, research, Agricultural Experiment Station, the University of Florida.

John Redd Hutcheson, director, Extension Work in Agriculture and Home Economics, Virginia Polytechnic Institute.

Thomas Barksdale Hutcheson, agronomist, Agricultural Experiment Station, head, Agronomy Department, Virginia Polytechnic Institute.

James Tertius Jardine, director of research, chief, Office of Experiment Stations, U. S. Department of Agriculture.

George Wannamaker Keitt, professor of plant pathology, the University of Wisconsin.

Asbury Francis Lever, director of public relations, Farm Credit Administration, Columbia, S. C.

Walter Hoge MacIntire, head, Department of Chemistry, the University of Tennessee Agricultural Experiment Station.

James Spencer McHargue, head, Department of Chemistry, Kentucky Agricultural Experiment Station, the University of Kentucky.

William Dewey Moore, pathologist, U. S. Department of Agriculture, Tifton, Ga.

John Harcourt Alexander Morgan, director, Tennessee Valley Authority, Knoxville.

Lake Rosse Neel, editor and writer, *Southern Agriculturist;* vice-director, Middle Tennessee Experiment Station, Columbia.

Wilmon Newell, dean, College of Agriculture; director, Agricultural Experiment Stations and Extension Service, the University of Florida.

Mark Lovel Nichols, principal engineer, Soil Conservation Service, U. S. Department of Agriculture.

Clarence Poe, president and editor, *The Progressive Farmer and Southern Ruralist,* Raleigh, N. C.

Robert Franklin Poole, professor of plant pathology, plant pathologist, chairman, Graduate Work Committee, North Carolina State College of Agriculture and Engineering, Raleigh.

Tandy Roy Reid, regional director, Resettlement Administration, Little Rock, Ark.

Roe Eugene Remington, professor of nutrition, Medical College of the State of South Carolina, Charleston.

Ira Obed Schaub, dean and director of Agricultural Extension, North Carolina State College of Agriculture and Engineering, Raleigh.

Henry Perkins Stuckey, director and horticulturist, Georgia Experiment Station, Experiment.

Robert William Webb, principal cotton technologist, Bureau of Agricultural Economics, U. S. Department of Agriculture.

George James Wilds, director plant breeding, Coker's Pedigreed Seed Company, Hartsville, S. C.

Rhett Youmans Winters, director, Agricultural Experiment Station, North Carolina State College of Agriculture and Engineering, Raleigh.

Howard Henry Zimmerley, director, Virginia Truck Experiment Station, Norfolk, Va.

RECENT DEATHS AND MEMORIALS

DR. JOHN WYCKOFF, dean of New York University Medical College, died on June 2. He was in his fifty-sixth year.

MADISON GRANT, a founder of the New York Zoological Society and its president since 1925, died on May 30. He was seventy-one years old.

THE death is announced in his fiftieth year of Dr. Harold Bunce Myers, professor of medicine and assistant dean of the University of Oregon Medical School at Portland.

DR. LUCY SMITH CLEMENS, wife of Dr. W. A.

Clemens, director of the Pacific Biological Station, Nanaimo, B. C., died on May 23. She graduated from Mount Holyoke College in 1909 and received the doctorate degree from Cornell University in 1914. From 1912 to 1918 she was a member of the staff in zoology at Mount Holyoke College.

DR. JOHANNES WALTHER, professor emeritus of geology and paleontology at the University of Halle, died on May 3 at the age of seventy-seven years. In 1927 Dr. Walther spent several months in the United States as visiting professor at the Johns Hopkins University and at Columbia University.

ADMIRAL GOTTFRIED HANSEN, of Copenhagen, a member of the Arctic expeditions of Roald Amundsen, died on May 27. He was sixty-one years old.

A CIRCULATING library has been established at the Central Maine General Hospital, Lewiston, through a grant of the Bingham Associates, in honor of the late Dr. Frederic Henry Gerrish, formerly professor of anatomy at Bowdoin College Medical School, Portland. Material in the library, which now contains seventy-five journals, together with a large collection of reprints, will be available to all members of the State Medical Association.

SCIENTIFIC NOTES AND NEWS

THE Research Corporation of New York has awarded, through the Stevens Institute of Technology, plaques and the sum of $2,500 each to Professor Percy W. Bridgman, of Harvard University, and to Professor Ernest O. Lawrence, of the University of California, in recognition of their research in physics. The presentation was made at a dinner in New York City, presided over by Elon Huntington Hooker, chairman of the executive board of the Research Corporation, at which Dr. Harvey N. Davis, president of Stevens Institute, and Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, were the speakers.

AT the hundred and eighty-third commencement of Columbia University on June 1 the degree of doctor of science was conferred on Dr. John Howard Northrop, member of the Rockefeller Institute for Medical Research, and on Robert Broom, keeper of anthropology and vertebrate paleontology of the Transvaal Museum, Pretoria.

CLARK UNIVERSITY on June 5 conferred the honorary degree of doctor of science on Dr. H. H. Donaldson, member of the Wistar Institute of Anatomy and Biology, Philadelphia.

THE degree of doctor of science will be conferred on June 14 at the commencement of the Ohio State University on Dr. Charles Felton Scott, professor emeritus of electrical engineering at Yale University. He is a son of the late Dr. William Henry Scott, third president of the university, and a brother of the Rev. Dr. Herbert Scott, Pittsburgh, Pa., who will give the baccalaureate sermon on June 13.

FRANKLIN AND MARSHALL COLLEGE on June 2 conferred the doctorate of science on Dr. Frank Clifford Whitmore, dean of Pennsylvania State College.

ON May 31, Kansas State College conferred the honorary degree of doctor of science on Miss Flora Rose, '04, now director of the College of Home Economics at Cornell University, and on Dr. F. C. Sears, '92, emeritus professor of pomology at the Massachusetts State College.

DR. EDWARD A. BOYDEN, professor of anatomy at the University of Minnesota, was awarded the gold medal of the Southern Minnesota Medical Association for the best scientific exhibit at the annual meeting of the Minnesota State Medical Association, held in St. Paul on May 3. The medal was presented by Dr. A. W. Adson, of the Mayo Clinic, the retiring president of the association. Honorable mention was given to Dr. L. F. Hawkinson for endocrine studies and to Dr. Horace Newhart for his work on the prevention and amelioration of deafness.

ABOUT two hundred friends and colleagues of Professor W. J. Fraser honored him at a dinner on May 21. Professor Fraser will retire from active work in the University of Illinois at the close of the present academic year with the rank of professor emeritus. He was graduated from the University of Illinois in 1893 and in 1896 founded the department of dairy husbandry.

AUSTIN H. CLARK, of the U. S. National Museum, was authorized by an Act of Congress passed by the House of Representatives on June 1 and by the Senate previously to accept the Cross as a Knight of the Order of Dannebrog conferred upon him by the King of Denmark and Iceland.

DR. J. C. TH. UPHOF, of Orlando, Fla., was recently elected a corresponding member of the Dendrological Society of the Netherlands.

DR. OTTO HAHN, director of the Kaiser Wilhelm Institute for Chemistry and professor of chemistry at the University of Berlin, has been elected a corresponding member of the Bavarian Academy of Sciences.

OFFICERS of the North Central Branch of the Society of American Bacteriologists at the recent meeting in Madison, Wis., were elected as follows: Dr. William C. Frazier, of the department of agricultural bacteriol-

ogy of the University of Wisconsin, *president;* Dr. Max Levine, Iowa State College, *vice-president,* and Lyle A. Weed, University of Iowa, *secretary-treasurer.*

THE Columbia Chapter of Sigma Xi has elected the following officers to serve from June 1, 1937, to May 31, 1939: Professor Harold W. Webb, *president;* Professor Arthur W. Thomas, *vice-president,* and Professor Dana P. Mitchell, *secretary-treasurer.*

DR. T. S. PAINTER, professor of zoology at the University of Texas, has been appointed research professor for 1937–38. Dr. E. H. Sellards, professor of geology and director of the University Bureau of Economic Geology, held the position in 1936–37. This appointment is made each year by the board of regents on the basis of distinguished work. According to custom, Dr. Painter will deliver in the spring a series of lectures either of general or of technical interest embodying the results of his research.

DR. DAVID HILL TENNENT, head of the department of biology at Bryn Mawr College, has been appointed research professor for a five-year term. This is the first full-time professorship with no teaching duties at Bryn Mawr College. It has been made possible by a recent gift to the college.

PROFESSOR HENRY H. W. KEITH, of the Massachusetts Institute of Technology, has been appointed head of the department of naval architecture and marine engineering.

DR. PETER VAN DE KAMP, of the Leander McCormick Observatory of the University of Virginia, has been appointed associate professor of astronomy at Swarthmore College and director of the Sproul Observatory.

DR. G. R. WENDT, of the University of Virginia, has been appointed assistant professor of psychology at the University of Pennsylvania.

DR. VICTOR WEISSKOPF, of Copenhagen, who has been for the past several years a research assistant to Professor Niels Bohr and who had previously served in the same capacity with Professor W. Pauli at Zurich, has been made instructor in physics at the University of Rochester.

DR. THOMAS B. MAGATH, of the Mayo Clinic, has become health officer of the city of Rochester, Minn. He succeeds Dr. Charles H. Mayo, who has been health officer for the past twenty-five years.

PROFESSOR GURTH WHIPPLE, acting director of forest extension at the New York State College of Forestry, Syracuse, has been promoted to the position of director, succeeding the late Professor Frank B. Myers, who died on February 14.

PROFESSOR BERWIND P. KAUFMANN, head of the department of botany at the University of Alabama, has resigned to join the staff of the Department of Genetics of the Carnegie Institution of Washington at Cold Spring Harbor, N. Y., where he has been visiting investigator on leave of absence since February. He will continue his work on the cytology of Drosophila in cooperation with Dr. M. Demerec, assistant director of the department of genetics.

DR. E. M. LINDSAY, assistant at the Harvard Observatory in Bloemfontein, South Africa, has been appointed astronomer at Armagh Observatory, Ireland.

RENE GOVEIL, formerly of the Dominion Entomological Service at Ottawa, has been named chief entomologist of the Quebec Department of Lands and Forests.

DR. E. B. WORTHINGTON, of the University of Cambridge, has been appointed director of the laboratory of the Freshwater Biological Association of the British Empire. The association maintains a laboratory at Wray Castle on Windermere in which investigations are carried out on the zoology and botany of fresh waters.

DR. J. S. PLASKETT, director emeritus of the Dominion Astrophysical Observatory, Victoria, B. C., has returned from a three weeks' visit to Cleveland. There, in his capacity as scientific consultant of the Warner and Swasey Company, he has been observing progress and consulting on methods in the figuring of the 82-inch mirror for the McDonald Observatory in Texas.

DR. ERNEST O. LAWRENCE, of the University of California, delivered on May 10 the annual address to the University of Cincinnati Chapter of Sigma Xi, on "Atoms, New and Old."

DR. OSCAR RIDDLE, of the Carnegie Institution, Station for Experimental Evolution, Cold Spring Harbor, N. Y., on April 27 addressed the Ohio State University Chapter of Sigma Xi on "The Hormones of the Anterior Pituitary Gland."

DR. L. C. GRATON, professor of mining geology at Harvard University, gave the address at the annual meeting on May 18 of the Harvard Chapter of Sigma Xi. The subject treated was "Controversies Regarding the Origin of Ores."

PROFESSOR C. L. METCALF, head of the department of entomology at the University of Illinois and president of the Illinois Chapter of Sigma Xi, gave the address entitled "The Morbific Triangle" at the annual meeting on May 13 of the College of Medicine Chapter in Chicago.

DR. G. W. MCCOY, medical director of the U. S. Public Health Service, Washington, D. C., addressed the members of the Dugas Journal Club of the School of Medicine of the University of Georgia on May 1[illegible]

Dr. McCoy discussed the relationship of epidemiology to public health.

SIR HENRY DALE, director of the National Institute for Medical Research, Hampstead, London, was the guest speaker on May 18 at the Academy of Medicine of Washington, D. C. Dr. Dale spoke of his researches into the mechanisms of transmission of excitation from nerve ending to end organ. The address was preceded by a dinner at which announcement was made of the election of Dr. Dale to honorary membership in the academy.

THE next annual meeting of the American Society of Zoologists will be held in Indianapolis on December 28, 29 and 30 in association with Section F of the American Association for the Advancement of Science. All sessions for the reading of papers and for demonstrations will be held at the Indiana University School of Medicine. Titles and abstracts of papers and demonstrations to be presented by members of the society should be sent to the secretary, E. G. Butler, Princeton University, Princeton, N. J., before November 8.

THE summer meeting of the Genetics Society of America will be held at Woods Hole on August 31 and September 1. On the evening of August 30 a lecture will be delivered by Dr. Boris Ephrussi, of the Institut de Biologie Physico-Chimique, Paris. Two sessions of the program will be devoted to round table conferences on different methods of study as applied to problems of genetics. These conferences are being organized by Professor L. C. Dunn, who will act as leader in the discussions. The different topics will be introduced by: W. Landauer, E. W. Sinnott, H. B. Tukey, D. F. Poulson, B. Ephrussi, E. Hadorn, M. Demerec and others. One session has been reserved for demonstration papers.

THE Carolina Geological Society was formed by a group interested in earth sciences, meeting at the invitation of Professor W. C. Holland, of the department of geology of Furman University, Greenville, S. C., on May 15. The object of the society is to promote the sciences of geography, geology, metallurgy, mining, ceramics and soil science in North and South Carolina. It was decided to hold annual field trips of from one to two days each autumn. Professor W. C. Holland was elected *president;* Berlen C. Moneymaker, of the Tennessee Valley Authority, Murphy, N. C., *vice-president,* and Professor Willard Berry, Duke University, *secretary-treasurer.* Professor G. R. MacCarthy, of the University of North Carolina, was elected chairman of the membership committee.

THE Rocky Mountain Biological Laboratory at Crested Butte, Colo., will be opened on June 28 to enable biologists who attend the Denver meeting of the American Association for the Advancement of Science to leave immediately afterwards for a visit, or for a longer period of investigation, study and recreation. A three-day excursion to the laboratory, beginning on Sunday, June 27, is being arranged from Denver. The cost of the trip will be approximately $12.00, including lodging (3 nights), meals and transportation by auto, covering in the round trip some 570 miles in the heart of the Rockies. The laboratory centers its activities around problems of the alpine and subalpine regions. Those wishing to take part in the excursion should communicate with the director of the laboratory, Dr. John C. Johnson, Pennsylvania State Teachers College, West Chester.

THE *Journal* of the American Medical Association reports that under the recent reorganization of the Scientific Research Division of the U. S. Public Health Service, effective on February 1, three new divisions were established at the National Institute of Health: the division of biologic control under the direction of Senior Surgeon Walter T. Harrison; the division of public health methods, which incorporates the work of the former field office of public health methods with the work of the offices of child hygiene, milk investigations, statistical investigations and the laboratory of stream pollution investigations, under the direction of Surgeon Joseph W. Mountin, and the division of industrial hygiene, which coordinates the work of the former office of industrial hygiene and the extensive laboratory studies of occupational dermatoses carried on at the National Institute of Health, under the supervision of Senior Surgeon Royd R. Sayers. The former division of bacteriology and pathology was further reorganized so that part of the division relating to bacteriology is known as the division of infectious diseases. Under the direction of Senior Surgeon Rolla E. Dyer, this division covers the field and laboratory work relating to infectious diseases, including leprosy studies, malaria investigations, the Rocky Mountain Laboratory, tuberculosis and epidemiologic studies. The division of pathology now includes the field office of cancer investigations. The former divisions of chemistry, pharmacology and zoology of the institute remain under the direction of Drs. Claude S. Hudson, Carl Voegtlin and Maurice C. Hall, respectively.

AN expedition to the Pribilof Islands in the Bering Sea, off the coast of Alaska, to collect fur seals for a projected habitat group for the Field Museum, Chicago, is leaving early in June. It is planned to collect more than thirty specimens of both sexes and of various ages. The group, illustrating the "home life" of the animals, will reproduce a rookery or breeding ground. It will be installed in the Hall of Marine Mammals. The leader of the expedition, C. J. Albrecht, taxidermist, who worked in the same region a

number of years ago, will spend the greater part of the summer in the islands, living among the native Aleut inhabitants.

A WIRELESS dispatch from Berlin to *The New York Times* reports that in the presence of Chancellor Adolf Hitler the Reich Research Council was inaugurated on May 25. National Socialist Cabinet members and a large body of scientific men attended. The new organization was created especially to further the four-year plan. Minister of Education Bernhard Rust explained that technical and natural science research would be pursued systematically by the council, Germany's economic self-sufficiency being the objective. General Karl Becker outlined the principal departments of the new institution as follows: physics, chemistry and physical chemistry, automotive power, rubber, textiles, fats, cellulose, non-ferrous metals, mineralogy, geology, biology, including zoology and forestry, the technical side of defense research, electrotechnic mining, iron and steel, medical research and preventive medicine.

DISCUSSION

STYLISTIC INFELICITIES AND THE EXCESS WORD

MR. URBACH, of the department of English and history of the Massachusetts Institute of Technology, recently[1] has complained about the bad writing manners of "a great many American scientists." He is particularly aggravated about "stylistic infelicities," "excess words," circumlocutions and mixed metaphors, of which he gives a number of examples "from the current writings of scientists." Perhaps because these examples were all taken from the writings of social and biological scientists, the pertinent comments to date have been limited to one from a psychologist[2] and another from a botanist.[3]

Any one who has had to correct theses in the making is apt to lend a sympathetic ear to Mr. Urbach's complaints. But in reading the works of most full-fledged physical and biological scientists one is constantly amazed not that they write so poorly, but rather that they express themselves so well. It is true that some have a minor genius for mixing metaphors, yet few have produced such classics as, "I smell a rat, I'll nip it in the bud." And even the Bard of Avon did not lose his reputation when he wrote: "to take arms against a sea of troubles." Furthermore, however common or reprehensible may be *such* "stylistic infelicities" in scientific writing, the average scientist is not a habitual criminal when it comes to the sin of the *"excess word."* Not only is he likely to express himself succinctly, but, if he errs, there are the watchful editors of scientific journals to insist that the verbose mind their verbiage and to urge the commonly curt to become more consistently concise. There is a deluge of scientific papers submitted for publication, and a dearth of journals wherein they may be printed. So that, instead of the truly classical writings of some of the older scientists, we now of necessity can have only a sort of scientific shorthand which should be criticized not for the "excess word," but for the excised phrase.

We are all professionals at finding fault with our colleagues' writings, but we are tyros at correcting our own; nevertheless, since Mr. Urbach brought up this matter of the "excess word," perhaps he will permit us to examine his note in the light of his own criticism. He began:

"During the last six months I have analyzed from the point of view of their composition perhaps fifty scientific articles. My survey (if merely red-penciling errors and stylistic infelicities may be so dignified) was startling in its revelation of how badly a great many American scientists do write." Few real scientists would venture to express themselves in such a prodigal fashion. Many would have written:

"An analysis of the composition of some fifty scientific articles reveals how badly a great many American scientists write." And some editors would even blue pencil four of the nineteen words surviving out of the original forty-nine.

Mr. Urbach continued his discussion with two juicy paragraphs from which the average scientific writer could squeeze a veritable stream of "excess words," before he even arrived at his stated consideration of the crime of wordiness as illustrated by the writings of a number of scientific culprits. He began his treatment of the subject:

"Nothing makes for more cumbersome, pedantic writing than the use of unnecessary words." Nine of these very words are certainly unnecessary. Most scientists would write:

"Unnecessary words make cumbersome writing." And there are some disgruntled writers who would insist that scientific editors, with their fine disregard for context, might feel that even "Words make writing" was sufficient.

Mr. Urbach then goes on to cite another horrible example of the "excess word," apparently from the writings of some unsuspecting political scientist, concerning whose efforts he says:

"The italicized words boil down to 'undoubtedly

[1] W. F. Urbach, SCIENCE, 84: 390–391, October 30, 1936.
[2] E. G. Boring, SCIENCE, 84: 457–459, 1936.
[3] H. W. Rickett, SCIENCE, 85: 45–46, 1937.

use'; the two sentences become one. Of the four- words, twelve are unnecessary. Perhaps even the phrase, 'to be reckoned with,' is a bit superfluous, "

translated into the language of the scientist the cess words" are removed and there results:

Since the italicized words mean 'undoubtedly be- se,' twelve are unnecessary. Even 'to be reckoned h' is superfluous." But of course we are belaboring point. Almost any paragraph or sentence can be densed, but commonly such reduction engenders her than aborts "stylistic infelicities," and it usually ys havoc with the original thought as well. Never- less, in this day, when the scientist is blamed for t every excess under the sun, it may be well to st again that he is not generally guilty of "excess ds." True, he may not be a hardened criminal ply because he can't help himself. For instance, ecent number of the *Bulletin* of the Geological iety of America contained seven important descrip- papers, all of which had been thoroughly revised the editorial board. Each had been materially re- ed of the "excess word," the longest by as much 42 per cent., or from 104 pages of manuscript to Moreover, were this particular journal not heavily bsidized, papers of more than 20 pages, however portant, probably would rarely be accepted. In the ds of chemistry, physics and mathematics the situa- n is still more acute, for even epoch-making discov- s must be reported on a printed page or two. stead of "excess words" in such papers there unfor- nately may be almost no words at all.

To-day, when politicians, political and social scien- s, novelists, administrators and reformers are all llowing in a plethora of ambiguous words, it is an omalous situation that many concise, unequivocal ientific statements of some real consequence remain published. Therefore, although I admit both the neral validity and value of Mr. Urbach's criticisms, suggest that if he is really looking for the "excess rd" he turn from scientific writings to more likely urces. He might delve into the *Congressional Rec- d*, a metropolitan apartment lease, an income tax rm, the public utterances of high officials or a certain vel which requires a thousand pages to portray what neral Sherman, a scientifically trained soldier, aptly scribed in three words.

CAREY CRONEIS

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HAS UTAH LOST CLAIM TO THE LOWER SONORAN ZONE?

FEW spots in the West have aroused more interest the student of plant and animal distribution than a restricted area in the vicinity of St. George, Utah, located in the extreme southwestern corner of the state. The unusualness of this locality lies in the fact that it is a typical Covillea belt of approximately 350 square miles, surrounded on all sides by cold temperate flora except for a narrow, continuous strip of Lower Sonoran vegetation extending along the Virgin River through southern Nevada.

The St. George area has for centuries represented an extreme northern tongue of the southern desert shrub type. In October, 1776, Father Escalante described the presence of mesquite and numerous flowers blooming along the streams in the vicinity of St. George and contrasted the weather here with the bitterness of winter which he encountered but a few miles to the north. Brigham Young in 1850, realizing the semi-tropical nature of the locality, directed the immediate settlement of Utah's Dixie for the expressed purpose of growing cotton. In this part of the state the settlers grew not only cotton successfully, but also semi-tropical fruits, such as figs, pomegranates and grapes of various varieties.

Since the establishment of a weather station at St. George in 1890 sub-zero weather has been experienced in only three winters. On January 2, 1901, a low of –1° F. was recorded, but this extreme was of short duration and no damage to cultivated crops or native vegetation apparently resulted. During the winter of 1909, when low temperatures of – 4° F. were recorded for three consecutive days, December 25, 26 and 27, figs and pomegranates were damaged considerably, but the native vegetation seemed to escape noticeable injury. January, 1937, brought the lowest and most extended duration of extreme temperature ever known in the St. George area. The following lows with dates appear in the weather bureau records: Jan. 21 –9° F., Jan. 22 –11° F., Jan. 23 –1° F., Jan. 24 –2° F., Jan. 25 –1° F., Jan. 26 –11° F., Jan. 27 –7° F. Widespread destruction to tender varieties of grapes, figs and pomegranates is now evident, and the chief plant indicators of the Lower Sonoran Zone, such as *Covillea tridentata* and the two mesquites, *Strombocarpa odorata* and *Prosopis glandulosa,* appear to be dead. Whether or not some of this native vegetation will throw new shoots later remains to be seen, but brown, water-soaked cambium layers even at the crown of most shrubs observed throws doubt on this possibility.

Aside from the suddenness with which vegetation may be eliminated from a rather considerable area, the tragedy of this prank of nature has definite bearing on the fundamental concepts of the factors of climate governing plant distribution. Especially does this wide-spread destruction of vegetation due to continued low temperatures emphasize the inadequacy of Merriam's theory of zonation in its failure to take into

consideration temperature data of the dormant period. That the long duration of low extremes of temperature may be a critical factor in the wide-spread destruction of vegetation is further substantiated by the fact that the juniper of the upper limits of the Upper Sonoran Zone of southern Utah are bronze in appearance because of the rigors of the past winter. Whether repopulation of these damaged areas will be accomplished by means of seeds ripened last fall or whether a general altitudinal lowering of these vegetation zones will result, only time will tell.

WALTER P. COTTAM
UNIVERSITY OF UTAH

REGENERATION OF ULTRACENTRIFUGED ADRENAL TISSUE IN THE ALBINO RAT

IN a previous paper[1] the writer reported the cytological changes produced in rat adrenal cells by ultracentrifuging at 400,000 times the force of gravity. Briefly, such cells show marked stratification of their components according to relative specific gravity and the viscosity of the medium. In order to determine the capacity of these cells to retain their viability, to reconstitute, regenerate and function normally, autoplastic grafts have been made.

A significant series of rats averaging 50 days age were doubly adrenalectomized, a portion set aside as controls, and the remainder used for transplanting. In the latter group the excised glands were ultracentrifuged for 30 minutes, thereby producing maximum stratification, as described in the paper already referred to. These were then halved and two or three pieces grafted autoplastically into pockets cut into the abdominal muscles. Both the control and the transplanted rats were placed on a salt diet to guarantee a sufficient survival period in which the grafts might "take." After about 30 days the animals were returned to a normal diet to check the efficacy of the implants. Up to the present time (three months after adrenalectomy of the first lot) none of the implanted rats have died, except for a few whose death during the first 72 hours could be attributed to traumatic shock. On the other hand, most of the control animals (doubly adrenalectomized, but without implants) failed to survive even the first 30 days on salt diet. At the present writing some of the implanted animals have been killed, the grafts excised and serially sectioned, and thorough search made for accessory adrenal tissue which included serial sectioning of the original adrenal sites. In the cases so far examined no accessory tissue has been found; however, the ultracentrifuged implants show excellent and abundant regeneration of cortical tissue, but no medullary cells. Cytologically, the cortical cells appear normal, tho certain differences in the histological arrangement apparent. More detailed studies are in progress.

It appears, therefore, that the severe centrif displacement of cytological elements in adrenal tical cells does not hinder these cells from reconsti ing, regenerating and performing their normal phy logical functions. A complete and detailed accoun this work is in preparation and will be publis elsewhere.

ERNST J. DORNFE
DEPARTMENT OF ZOOLOGY
UNIVERSITY OF WISCONSIN

[1] Dornfeld, *Anat. Rec.*, 65: 403, 1936.

ABUNDANCE OF THE EUROPEAN STARLI IN ILLINOIS

SINCE its first appearance in Illinois, about fif years ago, the European starling has steadily increa in numbers until it may now be considered a p almost equal to that of the English sparrow. W first noted in Champaign County by Professor Fr Smith and the writer (1922), it was always obser in company with grackles, never in flocks by itself.

During several motor trips about the state the p winter this bird was observed in certain places in gr abundance. On March 7, while passing over route from Peoria to Forrest, eight flocks of starlings w noted, none of which contained less than 100 birds each flock. The flock was pure starling, no grack being noted in this part of the state at this time year. Going south on route 47 from Forrest to Mah met seven flocks of starlings were noted, each f estimated to contain at least 75 birds. An estimat of the total number of starlings seen on these t routes on this day gives over 1,300 birds. When t automobile passed the flock the birds rose in a gr cloud.

On March 8 and on April 4 trips were taken o route 10 to Decatur and over route 36 to Springf and no starlings were observed. This area is south that upon which the large flocks were seen.

Several years ago an attempt was made to red the immense numbers of the purple grackle wh infest the city of Urbana, and the police departm shot at evening time into several flocks which were p paring to roost for the night. Several hundred w killed, but there was not a starling among them. B curiously enough, there were many cowbirds; perha the flocks may have contained 15 per cent. of t species. As there were no starlings it seems evid that this species is here in sufficient numbers to flock itself and does not mingle with the grackles as formerl

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SOCIETIES AND MEETINGS

THE IOWA ACADEMY OF SCIENCE

THE fifty-first annual meeting of the Iowa Academy Science was held at the University of Dubuque and mbia College in Dubuque on April 16 and 17, 212 members and visitors in registered attendance. he presidential address, "Education and Industry," presented by Dr. L. P. Sherman, professor of mistry at Grinnell College. Other papers of gen- interest were "The Flow of Water in Unsaturated ls" by Dr. L. A. Richards, of Iowa State College, "The Mammals of Iowa," by Dr. Roy L. Abbott, he Iowa State Teachers College. Dr. A. J. Carl- professor of physiology at the University of Chi- o, represented the American Association for the vancement of Science at this meeting and also gave annual address. His subject was "Studies on the hanisms of Hunger, Appetite and Thirst."

he following general officers were elected for 7-38:

President, A. C. Trowbridge, State University of Iowa; *e-president*, J. N. Martin, Iowa State College; *Secre- -Treasurer* and *American Association for the Ad- cement of Science Representative*, J. C. Gilman, Iowa e College; *Editor*, Mrs. F. W. Nichols, Ames; *Execu- Committee*, W. C. Oelke, Grinnell College, and E. E. me, of Morningside College. Section chairmen were ted as follows: *Botany and Bacteriology*, F. B. Smith, a State College; *Chemistry, general and physical*, es A. Coss, Morningside College; *Chemistry, organic biological*, Otto Nitz, Parsons College; *Geology*, ise Fillman, Simpson College; *Mathematics*, L. E. rd, State University of Iowa; *Physics*, William nerth, Iowa State College; *Psychology*, Robert Leeper, rnell College; *Science Teaching*, S. M. Dietz, Iowa te College; *Zoology*, George Huff, Drake University.

he academy convened in eight sections for the sentation of 112 papers of special interest. A new tion on science teaching was organized. The Junior ademy of Science of Iowa met with the academy at the Dubuque Senior High School. Forty dele- es from 14 clubs were present. The total registered endance was 180. Dr. D. W. Morehouse, of Drake iversity, Dr. R. L. Abbott, of Iowa State Teachers llege, and Dr. J. A. Eldridge, of the State Univer- of Iowa, were speakers on the program.

J. C. GILMAN,
Secretary-Treasurer

THE TENNESSEE ACADEMY OF SCIENCE

THE spring meeting of the Tennessee Academy of ience was held on May 7 and 8 at Southwestern iversity, Memphis, Tenn. The program included Welcome to Southwestern" by the president, Dr. Charles E. Diehl, papers at three general sessions and at a special session of members interested primarily in physics, a dinner on Friday evening and "Demonstrations."

About three fourths of the papers were by members of the faculty and advanced students of Memphis and Nashville schools. Four departments of the University of Tennessee Medical School were represented: Pharmacology, J. B. Mitchell, Jr., "Biology of the Black Widow Spider"; Physiology, J. Victor Monk, "Nature and Significance of Phasmaphaeresis"; Histology, D. S. Pankratz, "Foetal Movements in Rabbits"—a colored motion picture; Medicine, L. A. Diggs, "Sickle Cells Anemia."

The Botany Section, having planned "a botanical foray in the Smoky Mountains" for June, did not hold a special meeting. However, the chairman of the section, Dr. Jesse M. Shaver, was present as usual with a number of beautiful pictures of wild flowers and ferns; and with a specialized camera at hand he showed how he had made them.

At the meeting of the physicists Dr. Peyton N. Rhodes, vice-president of the academy, who presided, exhibited several interesting lecture-table demonstrations, four papers were read and a committee was appointed to apply to the academy for the formation of a physics section.

Mr. F. W. Brist, chief of the U. S. Weather Bureau, Memphis, made an address at the dinner on Friday evening at the Peabody Hotel on the subject, "Weather and the Public."

The "Demonstrations," which included live specimens of thirty-six species of reptiles and amphibia of Reelfoot Lake collected by Malcolm V. Parker, of Southwestern University, was a unique and interesting feature of the Memphis meeting.

Dr. C. L. Baker, director of the Reelfoot Lake Biological Station, stated plans for research work to be carried on there next summer.

The next meeting of the academy will be held on November 26 and 27 at Nashville. Dr. McGill will represent the academy at the meeting of the American Association for the Advancement of Science and the Conference of State Academies of Science at the meeting in Indianapolis next December.

JOHN T. MCGILL,
Secretary

THE SOUTH CAROLINA ACADEMY OF SCIENCE

THE fourteenth annual meeting of the South Carolina Academy of Science was held at the University of South Carolina, Columbia, S. C., in joint session with

the South Carolina Section of the American Chemical Society and the South Carolina Section of the Southern Society for Psychology and Philosophy, on Saturday, May 1, 1937. More than two hundred members attended.

The morning session was devoted to papers of more general interest and the address, "The Ubiquitous Insect," of the retiring president, Professor Franklin Sherman, of Clemson College. The afternoon session was divided into sections of biology and chemistry.

At the business session the following officers for 1937–38 were elected:

President: Dr. J. E. Mills, Sonoco Products Company, Hartsville, S. C.
Vice-president: Dr. G. G. Naudain, Winthrop College, Rock Hill, S. C.
Secretary-Treasurer: Dr. F. W. Kinard, Medical College, Charleston, S. C.
Curator: Dr. J. E. Copenhaver, University of South C lina, Columbia, S. C.
Editor: To be appointed.
Executive Committee: Professor A. C. Carson, Univer of South Carolina; Professor Franklin Sherman, C son College; Dr. C. B. Waller, Wofford College; Velma Matthews, Coker College; Dr. J. C. Ki Newberry College.

The Jefferson Medal for the outstanding paper awarded to Dr. Roe E. Remington, of the Medical C lege, for a paper entitled "A Quantitative Techniq the Study of Goitre." The 1937 Research Fund granted to Drs. J. Hampton Hoch and Hillyer R sill, Jr., of the Medical College.

The next meeting will be held in the spring of 1 at Charleston, South Carolina.

F. W. Kinard,
Secretar

SPECIAL ARTICLES

ON THE STRUCTURE OF INSULIN

It has recently been shown[1] that the cyclol theory of protein structure,[2] originally developed with special reference to the structure both of unimolecular protein films[3] and of the multi-laminar proteins, logically implies the existence of "space-enclosing" protein molecules; these contain certain specific numbers of amino acid residues. In particular a certain series of space-enclosing cyclols C_1, . . . C_2, . . . C_n, . . . which comprise 72, 288, . . . $72n^2$, . . . amino acid residues have been constructed. The theory thus passes the test, to which any theory of protein structure must submit, of predicting in general terms the body of facts relating to the "globular" proteins established by Svedberg and his collaborators.[4]

In view of the fact that considerable data relating to insulin are now available, including the x-ray analysis of the structure of insulin crystals,[5] it was deemed worth while to investigate in detail how far any of these space-enclosing cyclol molecules which have now been constructed can be used as a basis for a discussion of the structure of insulin. The molecular weight of insulin is known accurately enough for it to be plain that C_1 is much too light and C_3 much too heavy. The only cyclol of the series which comes into question is therefore C_2. Here the number of residues is of the right order of magnitude.

Each space-enclosing molecule consists of a p of the cyclol fabric shown in Fig. 1, which by bend

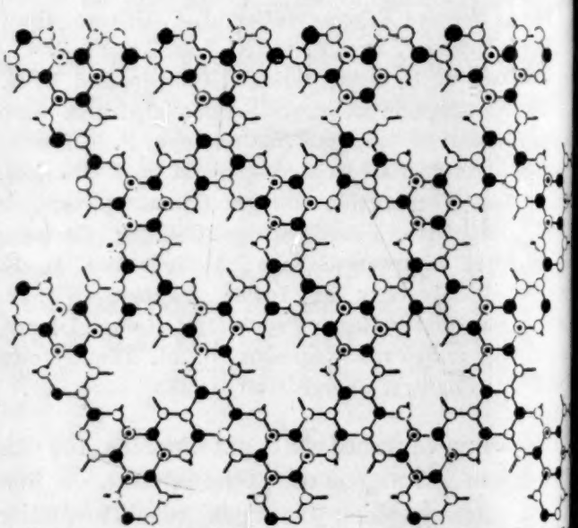

Fig. 1. The cyclol pattern. The median plane of lamina is the plane of the paper. The lamina has "front" surface above and its "back" surface b the paper.

● = N.
○ = C(OH), peptide hydroxyl upwards.
⊙ = C(OH), peptide hydroxyl downwards.
○— = CHR, direction of side chain initially outwa
○– = CHR, direction of side chain initially upwa

across one line after another joins up and so surrou a portion of space. For simplicity of exposition, cyclol fabric may be replaced by its median netw in which the C-C-N atoms in the constituent resi are replaced by points midway between linked at Various views of a model of the median network the molecule C_2 are shown in Fig. 2. This net lies on the surface of a truncated tetrahedron,

[1] D. M. Wrinch, *Nature*, 139: 1937 (in the press).
[2] D. M. Wrinch, *Nature*, 137, 411; 138, 241 and 651; 1936. *Proc. Roy. Soc. Lond. A.*, 160: 59, 1937.
[3] I. Langmuir, V. Schaefer and D. M. Wrinch, Science, 85: 76, 1937.
[4] T. Svedberg *et al.*, *Koll. Z.*, 51: 10, 1930. *Trans. Far. Soc.*, 26: 72 and 737, 1930. Science, 79: 327, 1934. *Biol. Bull.*, 66: 191, 1934. *Chem. Rev.*, 14: 1, 1935, and a series of papers in *Jour. Am. Chem. Soc.*, from 1929.
[5] D. Crowfoot, *Nature*, 135: 591, 1935.

possesses four triangular faces and four hexagonal faces. This polyhedral configuration is in agreement with Svedberg's deduction that insulin is a "globular"

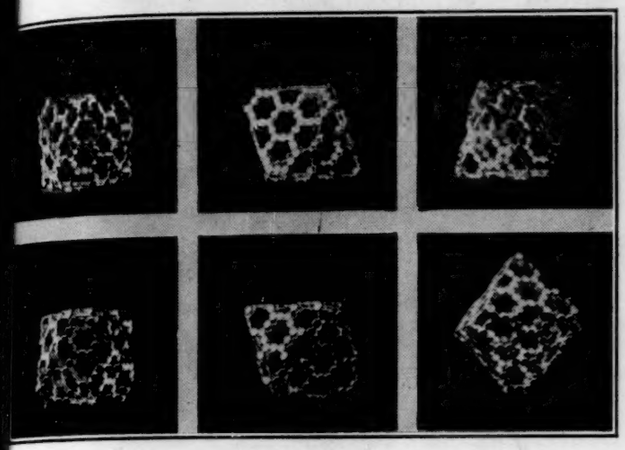

FIG. 2

molecule with low asymmetry number[6] and in fact offers an interpretation of the nature of this "globularity," which may be useful in the future in a quantitative interpretation of the asymmetry numbers of megamolecules in general. Further, since the C_2 structure (like all C_n structures) is a condensation of amino (or imino) acid molecules, no prosthetic group is required, in accordance with the chemical evidence.

The most stringent test of any proposed structure is afforded by the x-ray findings.[5] In the first place the insulin lattice has space group R3, and the unit cell is rhombohedral and contains one molecule only. Strictly interpreted, this means that the molecule itself has trigonal symmetry. Now for all the space-enclosing cyclols, the median network (which is to be regarded as a shorthand notation for the molecular structure, from which its essential features can be deduced) has four trigonal axes, if the distribution of different amino acids be left out of account. This symmetry requirement can then be met by any C_n and at the same time interpreted to mean that in the insulin molecule one hexagonal and one triangular face have the various residues trigonally arranged, while the three other hexagonal faces and also the three other triangular faces have identical arrangements of residues.

Next, the unit rhombohedral cell has $a = 44.3$A and $\alpha = 115°$. On working out the detailed geography of the structure proposed, it is found that the cyclol molecule C_2 (whose median network is shown in Fig. 2) fits easily and elegantly into this cell; furthermore, its structure suggests actual mechanisms of coordination in this megamolecular lattice. Thus the coordination between a molecule and its neighbors above and below at a distance 30.2A along the trigonal axis appears to be due to the simultaneous linking of a number of peptide hydroxyls. On the other hand each molecule appears to be linked severally to its six neighbors at distances 44.3A along the edges of the primitive rhombohedron by means of groups belonging to side chains, probably by the phenolic groups of tyrosine residues, which are held together by zinc (or other) cations. This mechanism accounts for the data of Scott which establish the fact that in insulin crystals there is a stoichiometric relation between the insulin content and the content of zinc, of cadmium or of cobalt.[7] The proportion is three cations to one molecule of insulin, which is in accordance with the mechanism of coordination suggested above, assuming that each insulin molecule has a half share of the six cations, located on the rhombohedral edges. The present suggestions thus fit in with and explain the view that crystalline insulin contains the metals as chemically combined constituents and not as mere impurities, and throws light also upon the fact[7] that the best acidity for the crystallization of insulin in the presence of certain metals is pH 6.0 to 6.2 on the alkaline side of the isoelectric point[8] pH 5.0 – 5.5.

Full details of the work will appear shortly.

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[6] T. Svedberg and I.-B.- Eriksson-Quensel, *Tabulae Biologicae Periodicae*, 5: 351, 1935–36.

THE DIFFUSION COEFFICIENT AND MOLECULAR SIZE OF VISUAL PURPLE

IN order to secure some notion of the molecular dimensions of visual purple, we have determined its diffusion coefficient by the method of Northrop and Anson.[1] This involves measuring the rate with which a dissolved substance passes from an enclosed solution into an outer solvent through a porous glass or alundum disk calibrated with substances of known diffusion coefficient.

The two basic properties of visual purple are its color and its light sensitivity. We have therefore relied on these criteria for measuring its diffusion. Using three different glass disks and four preparations of visual purple, we have obtained apparent diffusion coefficients of 0.0153, 0.0125, 0.0161 and 0.0152, with an average of 0.0148 sq. cm. per day at 6° C.

These values are probably not the real diffusion coefficients, because the glass disks become clogged during the manipulations. The clogging happens rapidly and then stops; after diffusion equilibrium with visual purple has become established over night the rate usually remains constant for as long as we have measured it, in one case for a week.

To estimate this clogging factor we calibrated the disks as usual with 2 M NaCl before the visual purple

[7] D. A. Scott and A. M. Fisher, *Biochem. Jour.*, 29: 1048, 1935.

[8] F. O. Howitt and E. B. R. Prideaux, *Proc. Roy. Soc. Lond. B.*, 112: 13, 1932.

[1] J. H. Northrop and M. L. Anson, *Jour. Gen. Physiol.*, 12: 543, 1929.

was introduced into the diffusion cell; then the calibration was repeated after the establishment of a steady state of diffusion, with the visual purple still in the cell. With two preparations of visual purple the first calibration gives an average diffusion coefficient of 0.0156, while the second calibration makes it 0.0190 sq. cm. per day. The latter is probably more nearly correct, because the second calibration records the actual state of the disk during the diffusion of the visual purple.

Efforts to eliminate the clogging factor by using alundum disks were not satisfactory because they trapped air easily, and the individual determinations varied widely (from 0.0108 to 0.0177 sq. cm./day) even in a single run. However, the values are of the same order of magnitude as with the glass disks.

To derive the molecular size of visual purple from diffusion data involves the application of Einstein's[2] equation which relates the diffusion coefficient to the radius of the molecule by way of the coefficient of friction and Stokes's law. Such an application is quite reasonable,[3] provided one is interested only in an order of magnitude. Taking the diffusion constant as 0.0148 sq. cm./day, the equations yield 8.04×10^{-7} cm. as the radius of the molecule of visual purple; using the more probable value of 0.0190 sq. cm./day, the radius becomes 6.26×10^{-7} cm. Either of these values shows visual purple to be a large molecule of the size heretofore found only for proteins. Its molecular volume computed from the smaller and more probable radius is 623,000; and if its specific gravity is 1.3 like that of most proteins, its molecular weight is 810,000.

Molecular weights computed from diffusion coefficients are frequently higher, often by a factor of 2 or even 3, than those computed from osmotic pressure or sedimentation data. The real molecular weight of visual purple may therefore be half or even a third of the value here given. For our purposes, this is of minor importance because even so it would still be a very large molecule of the kind found only among the proteins.[4]

This is powerful evidence that visual purple is really a protein, and agrees with Kühne's[5] inability to separate visual purple from the neurokeratin of the rods, and with his demonstration of the high temperature coefficient of its thermal destruction. Adding Wald's contribution[6] that visual purple liberates a carotenoid when it is bleached by light or acted upon by chloroform, it definitely places visual purple among the conjugated proteins—the carotenoid proteins.

[2] A. Einstein, *Z. Elektrochem.*, 14: 235, 1908.
[3] M. L. Anson and J. H. Northrop, *Jour. Gen. Physiol.*, 20: 575, 1937.
[4] T. Svedberg, *Trans. Faraday Soc.*, 26: 740, 1930.
[5] W. Kühne, in *Hermann's Handbuch d. Physiol.*, 3 (1): 235, 1879.
[6] G. Wald, *Jour. Gen. Physiol.*, 19: 351, 1935.

The visual purple solutions were prepared as previously described,[7] and were buffered with borate-KCl to a pH of 9. The glass disks of porosity 4G had a diameter of 30 mm and were about 0.5 mm thick. The inner diffusion cell contained 10 cc of visual purple solution, and the outer cell contained 7 cc of solvent—either digitonin or bile salts solution—also buffered to pH 9. When the disks were to be calibrated after the diffusion had reached equilibrium, NaCl was added at the beginning to both the visual purple and the outside solutions to make a concentration of 2 M; then when the diffusion rate had become constant, we determined the passage of the NaCl into an outer digitonin solution without NaCl. The entire apparatus was immersed in a water bath at 6° C. in a dark cold-room kept at the same temperature. The water bath was carefully mounted on rubber and then on a heavy concrete block to avoid undue vibration. The concentration of visual purple was determined with a photoelectric spectrophotometer, using as a measure the difference in photometric density at 500 mμ between the unbleached and subsequently bleached solution. The pH of 9 is to avoid any regeneration after bleaching. The experiments were made during the past year, and were aided by a grant from the Rockefeller Foundation.

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RATE OF MATURATION OF YOUNG RED CELLS IN CANARIES

THE erythrocytes that are present in the peripheral blood of birds may be separated into three types, all of which are nucleated.

(1) Nucleated basophilic erythrocytes are spheroidal in shape, free from hemoglobin and stain only with basic dyes. The nucleus is large and spheroidal, and the chromatin is coarsely reticulated. Only a fraction of one per cent. of these occur in the peripheral blood of canaries.

(2) Nucleated amphophilic erythrocytes are spheroidal or elongate in shape, contain a small amount of hemoglobin and stain with either acid or basic dyes. The nucleus is large and oval in shape and the chromatin is present in the form of irregularly shaped clumps of various sizes; such nuclei are called polychromaphilic. Usually from one to 6 per cent. of these occur in the peripheral blood of canaries.

(3) Nucleated oxyphilic erythrocytes are spheroidal or elongate in shape, and contain hemoglobiniferous or oxyphilic cytoplasm. The nucleus is small, being

[7] S. Hecht, A. M. Chase, S. Shlaer and C. Haig, SCIENCE, 84: 331, 1936.

by about half as large as the nuclei in (1) and (2), and the chromatin is compact.

When stained by the Giemsa method, the cytoplasm of (1) and (2) is light blue or gray and that of (3) is light yellow or orange; the nucleus of (1) and (2) is a mottled purple, the reticulated chromatin and lumps of chromatin being clearly differentiated; the nucleus of (3) is a more or less uniform or homogeneous purple. Various stages intermediate between (1) and (2) and (2) and (3) occur.

Types (1) and (2) are considered to be "young red cells" and type (3) "old red cells." These young and old red cells are very easily distinguished from one another after being stained by the Giemsa method.

Several investigators have called attention to the fact that when the mature schizonts in the asexual cycle of certain species of malaria parasites of both man and birds undergo segmentation, the merozoites attack young red cells more readily than they do old red cells. The approximate rate of maturation of young red cells after they are liberated into the peripheral blood of the canary can be determined by observing the comparative age of the red cell and of the growing malaria parasite within it. *Plasmodium cathemerium* was used for our determinations. The merozoites of this species enter young red cells and the schizonts into which they develop grow to maturity in 24 hours; then they segment, giving rise to a new litter of usually from 12 to 20 merozoites. Synchronicity in the segmentation of *P. cathemerium* is pronounced; most of the schizonts segment in the early evening hours. At 10 P.M. most of the recently produced merozoites are present in young red cells. A few hours later the trophozoites have become obviously larger and the red cells have changed from stages (1) or (2) in the direction of stage (3). By the end of 21 hours, that is, at 7 P.M. on the succeeding day, only mature schizonts are present, and these are all in mature red cells. The conclusion reached is that the young parasitized red cells become mature within a period of 21 hours. The percentages of merozoites and mature parasites in young and old red cells obtained from a study of three birds are given in Table 1.

TABLE 1

Bird	Time	Merozoites in young cells	Time (21 hours later)	Mature trophozoites in old cells
1	10 P.M.	88.4 per cent.	7 P.M.	100 per cent.
2	"	75.3 " "	"	100 " "
3	"	84.6 " "	"	100 " "

The rate of maturation of these young red cells may have been accelerated or retarded because of the presence of the malaria parasites, hence the following *in vitro* experiments were carried out. Blood was drawn from canaries and kept at room temperature. Counts of young and old red cells were made at the time the blood was drawn and again at the end of 24 hours. The percentages of young cells present are given in Table 2.

TABLE 2

Bird	Young red cells in fresh blood	Young red cells after 24 hours
1	6 per cent.	0.4 per cent.
2	12.3 " "	0.2 " "
3	33.4 " "	0.2 " "

Birds 2 and 3 had been treated with phenylhydrazine in order to bring about an increase in the number of young red cells.

These *in vitro* experiments indicate that in drawn blood at room temperature practically all the young cells became mature within 24 hours. Thus the period required for the maturation of the young red cells in the peripheral blood of canaries appears to be less than 24 hours both in parasitized and in non-parasitized cells.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

EMBRYONIC SERIES IN SNAKES

DATA on Ophidian embryology are incomplete largely because of the difficulties involved in acquiring a satisfactory series of stages. Sacrifice of a gravid female yields an abundance of material of one stage, but to obtain a continuous record of development by this method would be almost impossible for rare or secretive snakes and both laborious and wasteful for common snakes.

To obviate this waste, Professor Peter Okkelberg, of the department of zoology of the University of Michigan, suggested that successive stages in development might presumably be obtained by a series of "Caesarean" operations on a single female. Such operations were begun in the summer of 1935 and proved highly successful.

Nembutal (sodium pentabarbital) is employed as the anesthetic. The strength most generally applicable is 0.5 per cent. in physiological saline solution. About two to three cc of this solution are injected intraperitoneally approximately at the middle of the body. Exact dosage is not important. Small snakes, such as *Diadophis* and *Tropidoclonion*, require proportionately less of the anesthetic (0.1 cc per 10 grams of

body weight) than larger snakes, such as *Natrix cyclopion floridana* Goff (1.0 cc per 30 grams of body weight). The former are fully anesthetized in from five to ten minutes and recover in six to twelve hours; the latter require one to two hours for complete anesthesia and recover in twenty-four to forty-eight hours. In approximately one hundred operations on snakes of a variety of Colubrid genera, both oviparous and ovoviviparous, no fatality has resulted from the anesthetic.

This rather striking and successful use of nembutal with cold-blooded vertebrates deserves special note. Although this anesthetic has been extensively used during the past several years both on humans and lower mammals, there is, to my knowledge, no record of its application to vertebrates below the mammals. The ill effects which sometimes accompany the use of respiratory anesthetics, such as ether and chloroform, were not apparent in snakes treated with nembutal. This observation should be of interest to workers in fields other than embryology.

The operation consists of the exposure of the oviduct by a short longitudinal abdominal slit slightly lateral to the mid-line and near the position of the most cranial embryo. The oviduct is then opened, and one or more embryos removed, the rest being left to continue development. It is not necessary to suture the oviduct and peritoneum, but the abdominal incision is closed by appressing the fleshy surfaces and securing them by a stitch of white linen thread at the base of each scute. On some ovoviviparous forms the process was repeated at intervals of three days; however, there is no reason to believe that a shorter interval would not be feasible. At each new operation, slits were made in progression posteriorly until all the embryos had been removed. I have had no opportunity to observe the effect of repeated operation on oviparous forms.

Removal of some embryos interferes in no way with the development of those remaining. Only one snake, *Thamnophis sirtalis sirtalis* (L.), was allowed to give birth to young after operation; from this specimen fourteen embryos had been removed in five weekly operations. The remaining two young were delivered at the expected time and were normal in every respect. During the summer of 1936 it was further observed that the rate of development was precisely the same in both operated and unoperated snakes which had been kept under the same laboratory conditions.

By this method it has been possible to secure embryonic material in series; it seems that this could have been accomplished in no other practical way.

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PHOTOGRAPHY IN THE BIOLOGY CLASSROOM

NOTE-TAKING by means of the newer types of small cameras is a classroom technique being employed successfully by several students in my biology classes. Photomicrographs of the various slides being used in laboratory can easily be taken by using a photomicrographic collar attachment set at infinity, with an exposure of from 3 to 10 seconds on Super-Pan film. The microscope may be focused in the usual way, using light from an ordinary table microscope lamp. These photographs, when mounted and supplemented with descriptive sketches and labels, make a most attractive and useful notebook record of laboratory work. One student, using an f.2 shutter and 1 second exposure on Super-X film, has regularly been photographing lantern slides as they are thrown on the screen during lectures and then using them to advantage as addenda to his written lecture notes. Several men on our teaching staff have also found that photographs of laboratory dissections and photomicrographs of slides and tissue preparations when properly enlarged, labeled and covered with Cellophane, may be successfully used as demonstrations for short practical laboratory quizzes on occasions when circumstances do not permit the preparation of actual specimens for large numbers of students.

P. L. BAILEY, JR.

COLLEGE OF THE CITY OF NEW YORK

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